Animal Welfare Information Center Newsletter

July-September 1993 Vol. 4, No. 3 ISSN: 1050-561X

Legislation Update

- **H.R. 2472 To promote the dissemination of biomedical information through modern methods of science and technology and to prevent the duplication of experiments on live animals, and for other purposes.**

Introduced June 18, 1993, by Robert G. Torricelli (D-NJ) and referred to the Committee on Energy and Commerce. This act may be cited as the "Information Dissemination and Research Accountability Act."

The purposes of this act are to establish a National Center for Research Accountability; provide for comprehensive, full-text literature searching before the approval of Federal funding for any research proposal involving the use of live animals; prevent duplicative experimentation or testing on live animals; promote advancement of modern technologies with respect to the storage and dissemination of biomedical information; provide, through grants, awards, and stipends, for training of additional biomedical information specialists in such modern technologies; make available at a reasonable cost the

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ALSO IN THIS ISSUE...

Environmental Enrichment for Captive Wildlife Through the Simulation of Gum-Feeding

by
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INTRODUCTION

Exudativory, or the use of plant gums, saps, resins and occasionally latex as a food source in an animal's diet, has been increasingly documented by field studies performed during the past 40 years (Nash, 1986) (Figure 1). Animals known to eat plant exudates are found among the prosimians, marmosets, tamarins, squirrels, marsupials, old world primates, and birds (Fleagle, 1988; MacDonald, 1984; Rylands, 1984; Post, 1983; Smith, 1982; Wrangham, 1981;

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Figure 1. Black-tailed marmoset licking gum that is dripping down a tree limb. *(Photo by Lee Miller)*

Bearder, et al., 1980; Charles-Dominique, 1977; Hausfater, et al. 1976; Izawa, 1975; Kilham, 1975; Tate, 1973; Radman, 1969). A literature search done in 1990 resulted in documentation of exudate-feeding in 45 species of animals (see table 1). However, the degree of dependency of animals on this food source is variable. For example, plant exudates are the major component of the natural diet of the Pygmy marmoset *(Cebuella pygmaea)* (Fleagle, 1988; Hershkovitz, 1977; Nash, 1986), Fork-marked lemur *(Phaner furcifer)* and other prosimians (Charles-Dominique, 1980; Oxnard, et al., 1990). These animals are considered "primary" gum-feeders based on their morphological, anatomical, physiological, and behavioral adaptations (Fleagle, 1988). "Secondary" gum-feeders are species that feed on plant exudates as a response to decreased fruit and flower availability, or climatic changes such as wet or dry seasons. Another factor that influences the degree to which animals rely on plant exudates is whether these exudate sources are water stressed, which results in low exudate production (Garber, 1984a; Nash, 1986; Lacher, et al., 1984). Exudate use also includes animals that ingest them opportunistically when they are found and animals that ingest exudates coincidentally when they eat, or perforate, bark down to the cambium layer during insect- or browse-feeding.

Between March 1988 and September 1990, I was a member of a behavioral research project at the Small Mammal House, National Zoological Park (NZP), Washington, D.C. Our objective was to apply the information, documented by field research about gummivory, to the captive management of our Pygmy marmosets, Black-tailed marmosets (*Callithrix argentata melanura*), and Geoffrey's marmosets (*C. geoffroyi*). We also offered gum arabic to other animals in the collection such as Lion tamarins *(Leontopithecus* spp.), Goeldi's monkey (*Callimico goeldi*), Low's squirrel (*Sundasciurus lowi*), Sugar gliders (*Petarus breviceps*), Prevost's squirrels (*Callisciurus prevosti*), and Cuban hutias (*Capromys pilorides*). All of these animals, except for the Sugar gliders, were on exhibit during our study. Since our experience is with gum-feeding, I will use the term gummivory, or gum-feeding, to be synonymous with the term exudativory. The following information presents the results of our research experiences, gained knowledge, and the unexpected side benefits we obtained from simulating gummivory in captivity.

Table 1 - DOCUMENTED GUM AND SAP FEEDERS

Prosimians:	*Euticus elengatulus* - Needle-clawed Galago
	Galago alleni - Allen's bushbaby
	G. senegalensis - Senegal bushbaby
	G. crassicaudatus - Thick-tailed bushbaby
	Galagoides demidovii - Dwarf galago
	Perodicticus potto - Potto
	Lemur catta - Ring-tailed lemur
	L. fulvus - Brown lemur
	Microcebus murinus - Mouse lemur
	Mirza coquereli - Coquerel's dwarf lemur
	Phaner furcifer - Fork-marked lemur
Marmosets:	*Callithrix argentata melanura* - Black-tailed marmoset
	C. a. aurita - Buffy tufted-ear marmoset
	C. flaviceps - Buffy-headed marmoset
	C. geoffroyi - Geoffrey's marmoset
	C. humeralifer - Tassel-ear marmoset
	C. jacchus - Common marmoset
	C. j. pencillata - Black tufted ear marmoset
	Cebuella pygmaea - Pygmy marmoset
Tamarins:	*Saguinus fuscicollis* - Saddle-back tamarin
	S. imperator - Emperor tamarin
	S. labiatus - Red-bellied tamarin
	S. midas - Golden-handed tamarin
	S. nigricollis - Black-mantle tamarin
	S. oedipus - Cotton-topped tamarin
	S. o. geoffroyi - Geoffrey's tamarin
Squirrels:	*Hylopetes spadiceus* - Red-cheeked squirrel
	Microsceurus - Pygmy squirrel
	Sciurus vulgaris - Red squirrel
	Sundasciurus lowii - Low's squirrel
	S. tenuis - Slender squirrel
Old World Monkeys:	*Cercopithecus aethiops* - Vervet monkey
	Erythrocebus patas - Patas monkey
	Papio c. cynocephalus - Yellow baboon
	Macaca sylvanus - Barbary macaque
	Pan troglodytes - Chimpanzee
Marsupials	*Gymnobelideus leadbeateri* - Leadbeater's possum
	Petaurus australis - Yellow bellied glider
	P. breviceps - Sugar glider
Other Mammals:	*Ursus americanus* - Black bear
	Loxodonta africana - African elephant (in Amboseli)
Birds:	*Artideotis kori* - Kori bustard
	Coua cristata - Crested coua (Madagascar)
	Sphyrapicus varius - Yellow-bellied sapsucker

BIOLOGY OF GUMMIVORY

Anatomical Adaptations

Generally, animals that use plant exudates are small bodied, have a high metabolism, and are incapable of storing large amounts of fat. "Primary" gum-eaters have most, or all, of the following traits: small body size, clawed digits (for vertical clinging at gum sources), long procumbent or semi-procumbent incisors complimented by short lower canines (providing a level gouging/scrapping surface), loss of enamel on the lingual side of the lower incisors complimented by honing upper incisors (providing a "sharpening" effect that permits gouging or scraping abilities), a V-shaped configuration of the mandibular arch, a long tongue (to reach gums within the plant bark), and an enlarged cecum (to allow for fermentation of the gums) (Fleagle, 1988; Coimbra-Filho, et al., 1978; Rosenberger, 1978; Hershkovitz, 1977).

Nutritional Factors Associated With Gum-feeding

Gums are a high-energy food source composed mainly of water, complex polysaccharides, calcium, and trace minerals (iron, aluminum, silicon, potassium, magnesium, and sodium) (Nash, 1986). Calcium is important to all animals, especially female callitrichids (tamarins and marmosets) which commonly give birth to twins twice a year. It is during the lactation period that the females are usually impregnated by the male. Therefore, they are develop-

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Alternatives to Live Animal Models in Laser Surgery Training

by
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The Research Resources Facility at the Geogetown University Medical Center cosponsored the Annual Otolaryngic Cherry Blossom Conference with the American Academy of Otolaryngology Head and Neck Surgery on March 22, 1992. The purpose of the workshop was to give physicians in-depth training on the use of lasers in otolaryngology. Lasers have been used in the treatment of otolaryngological head and neck lesions since the early 1970's. The course provided the basics of laser physics, instrumentation and safety, and the future application of lasers in otolaryngology. Surgeons were given the opportunity to acquire hands-on clinical experience with soft tissue application of lasers in otolaryngology-head and neck surgery, while also being introduced to laser use in the international otolaryngology-head and neck community. The course provided an alternative to the use of live animals, which proved to be very beneficial. In place of live animals, isolated tissues obtained *ex vivo*, chicken, beef liver, eggs and inanimate objects were used to reduce both animal use and cost for the course. After speaking to several physicians after the course, it was found that many of them preferred using isolated tissues and/or produce rather than live animals.

The Animal Welfare Act (AWA) states that a principal investigator must consider alternative methods to a procedure that may cause momentary or slight pain or distress to an animal (AWA - 2.31 8.D). An investigator should use sources such as the U.S. Department of Agriculture's National Agricultural Library (NAL) and the Department of Health and Human Services National Library of Medicine (NLM) to obtain information on alternatives to animal use in research and in educational training seminars. The Animal Welfare Information Center (AWIC) of NAL can provide written narratives to investigators that indicate possible alternative models available for use in proposed procedures (AWA - 2.32 C5). Assurance that alternatives have been considered must be presented in the institution's annual report and when the institution is inspected by the USDA (AWA -2.36 B.1).

Alternative models for animal research have become a major consideration in the development of new protocols and in continuing educational training seminars. However, implementing alternative technologies and methods in research and in educational workshops does not necessarily mean banishing the animal model from the research environment. In current research and training seminars, certain methods are available that allow for the continued, but modified use of animals through the use of inanimate objects and non-living animal systems. The alternatives used in the Otolaryngology Head and Neck Surgery training seminar consisted of specimens isolated *ex vivo* from human and animal cadavers, inanimate models, and chicken eggs. The tissues isolated from the human cadavers consisted of tympanic membranes, inner ears, and cochleas. Tongues, epiglotti, and tracheas were harvested from the animal cadavers. The inanimate models provided a basis for the surgeons to understand and become familiar with different available laser types. These models consisted of moist and dry tongue depressors, wet and dry gauze squares, plexiglass squares, and metal spatulas.

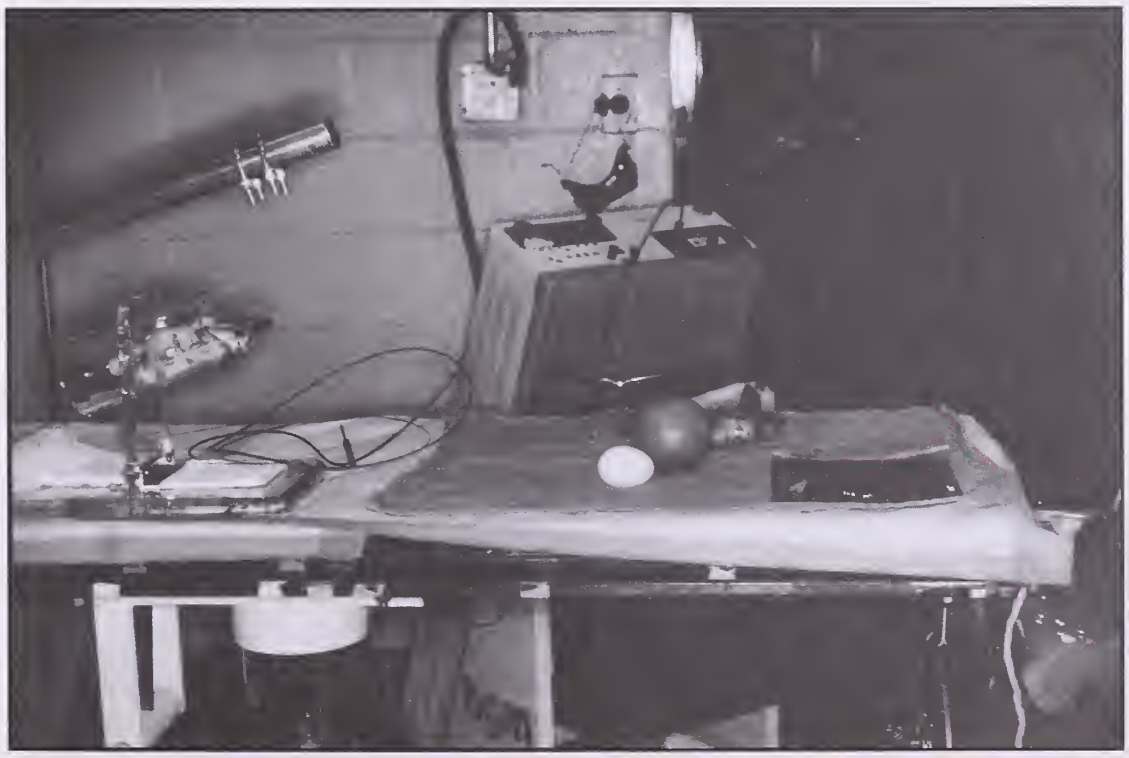

Figure 1. An example of isolated tissues and produce used as models.

Cost is always a major consideration when developing a protocol or organizing an educational training seminar. Although cost is not the main deciding factor, an investigator who uses an alternative model may reduce overall research costs. In the Otolaryngology Head and Neck Surgery training course, the cost of using the alternative models was much less than for the conventional animal model. By using the cadavers, inanimate models, and the produce (Figure 1), there was no housing or animal care fees in-

curred as there would have been with the conventional animal model. The only pre-operative preparation required was removing the tissues from the cadavers and arranging them in their appropriate apparatus, buying the produce from a grocery store, and arranging the various inanimate objects for easy access by the participants. In contrast, conventional animal models require pre-operative set-up that is much more involved and requires technical skill and ability in animal restraint, sedation, and patient monitoring during the training seminar.

PROCEDURES

The training course familiarized surgeons with three types of lasers: the KTP (Potassium Titanyl Phosphate) laser; the Nd:Yag (Neodymium doped Yttrium Aluminum Garnet crystal) laser; and the CO_2 (Carbon Dioxide) laser. The differences between the lasers are the wavelengths of light emitted. The KTP laser emits a green visible beam at 532 nm; the Nd:Yag laser emits an invisible infrared beam at 1064 nm; and the CO_2 laser emits an invisible infrared beam at 10,600 nm.

Laser applications were applied to moist and dry tongue depressors and to wet and dry gauze squares. The results obtained from these exercises indicated that the hydration of the target site affected the laser "burn" to the target area; too much water reflected the laser beam away from the target site. Dampened sites achieved similar "burns" as the dry sites but required less power. The plexiglass square was used to demonstrate the depth of damage from different power settings from each of the different lasers. The metal spatula was used to demonstrate the ability of the laser beam to be reflected 100 percent and have the same effect as a direct application of the laser beam to a target site. The hard-boiled chicken eggs were used to examine the laser application effects on a light-colored tissue. This demonstration indicated that there is no absorption of color from the laser beam by the white of the egg. Therefore, in order to demonstrate an effect from the laser, a higher power setting was needed. Tissue color effects were also examined using animal tissues obtained *ex vivo*. White chicken meat simulated effects on light-colored tissue, while red beef liver simulated colored tissue effects. The red liver absorbed more of the emitted light than the white meat which caused a more significant "burn." Also, the water content in chicken meat is less than that of the liver which will cause the applications of the laser to be less pronounced. We also used the skin of the chicken to provide a sense of various laser applications to epithelium.

Human and animal cadaver tissues were placed in holders in order for the surgeons to access various target sites. Once the trachea, epiglottis, and tongue systems were in place, the surgeons used the lasers to perform epiglottectomies, excision of an endolaryngeal mucosal lesion, cordectomy, and arytenoidectomy (Figure 2). Surgeons specializing in otology used human cadaver tissues to practice aural surgical techniques unique to their field.

The seminar participants were required to evaluate the workshop in a variety of areas. The participants, overall, felt that the laboratory materials were good to excellent. The surgeons also felt that the seminar will alter their practice performance and that the information gathered will help them in future otolaryngological surgical procedures.

The overall response to the workshop was positive, and the participants felt that the information obtained was beneficial and informative. The use of the alternative models satisfied the 3 R's of animal research – Refinement, Reduction, and Replacement. By using alternative methods, the number of animal lives and the cost of the surgical training course were greatly reduced.

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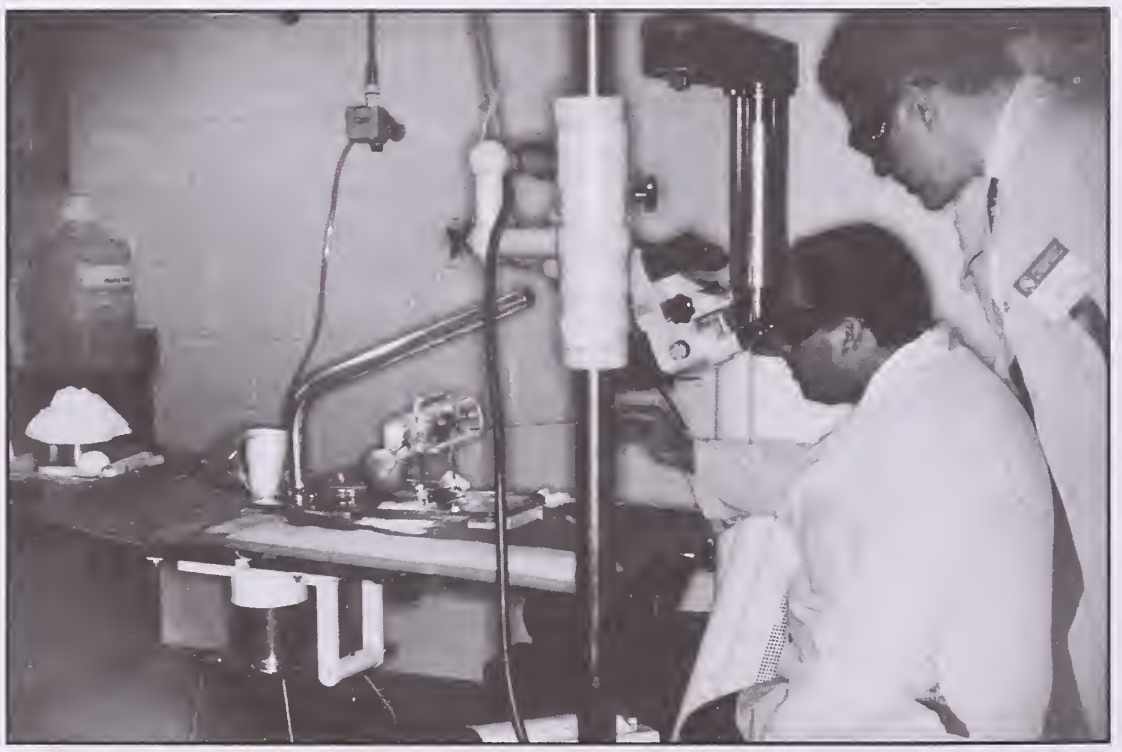

Figure 2. A surgeon performing an epiglottectomy.

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ing fetuses while nursing their fast-growing infants, resulting in an increased calcium demand. The calcium-to-phosphorus ratio is high in gums which offsets its ratio in insects, which is low. Because all known wild gummivores also include insects in their diet, combining the two, in captivity, may approach a desired nutritional balance and is recommended to avoid the possibility of nitrogen loss and the loss of protein from the body (Nash, 1986; Garber, 1984a; Sussman, et al., 1984; Coimbra-Filho, et al., 1978; Moynihan 1976).

Ecological Factors Associated With Gum-feeding

Gums from woody plants are reportedly available year round and are constant in their location (Bouchardet de Fonseca, et al., 1984; Ramirez, et al., 1978). This aspect allows marmosets, which are capable of eliciting gum flow, to be non-seasonal breeders and to subsist in small home ranges. Some tamarin species have been noted by field researchers to travel in association with marmosets and parasitize their gum sites.

It has been suggested that gums are an integral link in the food chain of gummivores (Soini, 1982). Some insects (moths, butterflies, ants) are attracted to the gum sites, while other insects simply get stuck in the sticky substance. These insects are often preyed upon by lizards and frogs. Gum-eaters prey on all of these animals, which reduces the amount of time and energy exerted in procuring animal protein in their diet. Gum-feeding typically occurs at the lower levels of the forest canopy (about 3 meters from the ground) where fruits and flowers are usually absent (Ramirez, 1978; Moynihan, 1976). The ability to subsist at this level lessens competition with other forest animals, which are predominantly frugivores or foliavores (Fleagle, 1988).

Gum-feeding is more than just another feeding strategy. It is the merging of the nutritional, ecological, behavioral, and evolutionary traits which allows species that are capable of using this resource to coexist in the wild.

Captive marmosets will instinctively gouge holes in exhibit furniture, despite the fact that they do not receive a food reward. Offspring of captive-born parents also gouge wood throughout their lives. The instinct to retain this behavior is so strong that infant marmosets in captivity demonstrate substrate "mouthing" behavior – the prerequisite to gouging behavior – as early as 3 weeks of age in Pygmy marmosets and at 5 weeks in Black-tailed marmosets (person. observ.).

NZP Research

In 1988, we began our research project by offering gum-feeders based upon McGrew's suggested artificial gum-feeder for marmosets (McGrew, 1986). These gum-feeders consisted of eight dowel segments with four drilled-out circular cavities (gum reservoirs) that were stacked onto a threaded, metal rod, secured with wing nuts, and wired onto the existing cage furniture. The marmosets not only accepted and fed from these gum-feeders, but became possessive of them when replacement was needed. Although the artificial feeders functioned, there were technical drawbacks. They required shop fabrication and needed to be soaked in water weekly because the dowel was very hard and dry. They were also unnatural in appearance, time-consuming to fill (filling with gum, feeder assembly, and installation of four feeders took approximately 2.5 hours per day), and they required weekly replacement. We abandoned this type of gum-feeder after 2 months and substituted natural branches for the dowel (gum reservoirs were simply holes drilled into the branch). Not only was this type of feeder accepted but it served as additional cage furniture that functioned as pathways and perches for the animals. This type of feeder provides the animals with a naturally textured substrate, is readily obtained, requires no assembly, and if "hard wood" is used, needs less frequent replacement (our hard wood feeders have been in place for 5 years). Filling these feeders can be accomplished in 5 to 10 minutes (Peterson, et al., 1988).

The following year we expanded the natural-branch idea to the use of floor-to-ceiling-length tree limbs, oriented in vertical and diagonal positions (Figure 2). This additional length of the feeders allowed us to

Figure 2. Black-tailed marmoset waiting for the keeper to fill holes on tree limb with gum arabic. (*Photo by Lee Miller*)

provide eight feeding sites (gum reservoirs) in three locations on each feeder — near the top, in the middle, and near the bottom.

Using checksheets and 45 trained volunteer behavior watchers, we observed for signs of differences in vertical versus diagonal preference, hard wood versus soft wood feeders, and preference of depth and dimension of drilled holes.

We also experimented with presenting the gum arabic/water solution in a rodent water bottle with a sipper tube (do not use tubes with a ball-bearing). We offered this modified gum-feeder in three ways: 1) inserted through one of our feeders, with the stem protruding; 2) hidden inside a piece of cork bark, with the stem protruding; and 3) affixed directly onto the wiring of a holding cage. The third method could be used for an animal that has been separated for health reasons or because of preshipment. It could also be used for enrichment in a laboratory situation where individual housing may be necessary for compliance with research protocol. Our objective was to make the gum available ad libitum, in hopes that the marmosets would teach us how often they use it.

Results of Providing Natural Wood Feeders to Marmosets

Data analysis (850 observation hours) revealed that the Pygmy marmosets (1.1.2, 1.1, 1.1) [Ed. Note: the first digit indicates the number of male animals, the second digit indicates the number of females, and the third, if present, indicates that the sex is unknown] used all gum sites on all feeders provided to them regardless of position, type of wood, or depth and dimension of drilled gum holes. The Black-tailed marmosets (1.1.2) demonstrated a preference for gum sites that were mid to upper level on vertical feeders. The Geoffrey's marmosets (1.1) used all feeders and feeding sites provided to them regardless of orientation, type of wood, or hole dimension.

Marmoset Behavioral Responses

The Pygmy marmosets shared feeders and even feeding sites without conflict. Over time, the Black-tailed marmosets became territorial over the feeders and a pronounced hierarchy system emerged within the family. The male Geoffrey's marmoset "hung back" and allowed the female first access to the gum sites. This behavior has been documented in some species of wild prosimians (Charles-Dominique, 1977).

One observation consistent among our marmoset species was that the use of "soft wood" feeders stimulated more scent marking and gouging behavior which resulted in marked damage to the feeders as well as to the existing cage furniture.

By providing gum feeders in vertical and diagonal orientations, we had unintentionally provided the marmosets with the opportunity to employ their widely recognized abilities as vertical clingers and leapers. When eating gum from the feeders, the marmosets often fed from an upside-down, clinging position — a posture not seen at other times. Gouging on feeders and eating gum from them required the marmosets to use muscles that are not used when locomoting quadrupedally on horizontal vines and branches — the typical exhibit furnishings provided in captive settings (Newman, et al., 1990; Garber, 1984b).

Benefits Resulting From Providing Gum-feeders to the Marmosets

1.) Increased animal activity level: The marmosets immediately come down to the feeders while the keeper is injecting the gum into the drilled holes via a syringe. They would also return to the feeders, at various times in the day, to scrape off and eat the dried gum overflow that adhered to the feeders' bark. This replicates the feeding pattern of their counterparts in the wild (Fleagle, 1988).

2.) Increased animal visibility: The Pygmy marmosets in all three exhibits will come within 2-3 inches of a caretaker while the gum is injected into the drilled holes, while the four Black-tailed marmosets and both Geoffrey's marmosets will eagerly eat the gum arabic directly from a syringe (Newman, et al., 1990). This simplifies the task of performing daily head counts of these animals.

3.) Close proximity to exhibit animals allows for health observations: Since the marmosets either eat the gum directly from a handheld syringe or come within inches of the caretaker, we have been able to detect early signs of pregnancy and detect and monitor minor injuries (cuts, scratches) and dental problems that do not require immediate treatment. We used the gum-filled syringe to encourage our young Black-tailed marmosets to stretch out for sex confirmation. We also used the gum-filled syringe to administer antibiotics to our adult, female Black-tailed marmoset who was diagnosed with a flagyl parasite infection (Figure 3). She refused her medication, even when hidden in her favorite food items, but accepted it when it was mixed into the gum arabic solution (Kelly, et al., 1989) and offered to her in the familiar syringe. Feeding gum arabic has proven to be a useful tool for animal caretakers to keep abreast of their animals' general health. The aspects of close proximity to the animals with its resulting observational benefits can be performed without physical manipulation or stress to the animals (Newman, et al., 1990).

4.) Visitor experience enhancement: Throughout our study, all of the gum-feeders were positioned near the public viewing side of each exhibit. The public responded to our gum-feeding project with interest and enthusiasm, and countless questions about the animals. It is exciting for zoo visitors to see a captive animal active and interacting with its environment. Other visitors appreciated the opportunity to get "close-up" photographs of the animals engaging in a natural behavior.

Gum-feeding Results in Lion Tamarins, Goeldi's Monkey, Marsupials, and Rodents

In the summer of 1989, we offered floor-to-ceiling-length wood feeders to a mixed bachelor group of Golden Lion tamarins (*Leontopithecus rosalia*) and Golden-headed Lion tamarins (*L. r. chrysomelas*) that were exhibited out-

Figure 3. A female Black-tailed marmoset is being given an antibiotic-gum arabic solution without being removed from her family, who are watching the procedure. (*Photo by Lee Miller*)

doors. The feeders became a source of interest and stimulation for the tamarins. Use of these feeders again illustrated species-specific behavior responses.

The Golden-headed Lion tamarins stripped off the bark over the gum sites to gain access to the gum that had been injected into the holes, whereas the Golden Lion tamarins were observed probing the gum-filled holes and then eating the gum from their fingers. The Golden-headed Lion tamarins also returned to the feeders later and stripped off additional bark from over the gum holes to gain access to any gum residue. At no time did we observe conflicts between the tamarin species over the gum (Kelly, et al., 1989).

When we injected the gum into a wide, circular depression on one of the feeders, both species of tamarins were observed using their cupped hand to scoop up the gum and eat it. This is the same method used in the wild to obtain rainwater from the cups of bromelids.

Our trial with Goeldi's monkey was limited to an individual female that was housed with our Black-tailed marmosets during our initial study in 1988. She did taste, and, on occasion, eat some of the gum, but she did not demonstrate strong attraction to it as did the marmosets and tamarins. We believe she was simply mimicking the Black-tail's responses to the gum. We have since learned that wild Goeldi's are not known to eat gums from woody plants, but do eat a sticky gum substance found on seed pods.

We were disappointed by our results with the Low's squirrel and the Sugar gliders. We offered a natural wood gum-feeder to a Low's squirrel and although the gum always disappeared, we never actually saw the squirrel using the feeder. It has been our experience that Low's squirrels are typically shy and secretive. The Sugar gliders (family group of five), however, stripped off large areas of bark from the feeders but ignored the gum sites. Further literature searches suggest they were probably searching for insects under the bark. Providing natural branches to Sugar gliders, even without gum, provides a stimulus to them which increases their activity level. Although both of these species are documented gum-eaters (MacDonald, 1984; Smith, 1982), the types of gum utilized by animals vary among species because of differences in geographic ranges and environmental factors. We used acacia gum extract in our trials which may not be the type of gum eaten by Low's squirrels and Sugar gliders.

One pair of Prevost squirrels in our study ate gum from the feeders as well as directly from the syringe. We do not place emphasis on their acceptance of the gum-feeders since this particular pair of squirrels were hand-raised and seek human interaction. The other pair of Prevost squirrels (parent-raised) in our study showed little-to-no interest in the gum or the feeders.

The responses of the Cuban hutias were surprising. Our four hutias were recently acquired, wild-caught animals. We do not have any documentation of gum-feeding in this species, but based on our theory that wood-eating species ingest gums, we offered the gum to them. The hutias, especially the females, ate the gum directly from the syringe but at no other time would they allow us close proximity to them. We have noticed that the females in all the trials, especially when pregnant, are usually the first animals to come for the gum.

Although we did not intentionally include Acouchis (*Myopracta pratti*) in our gum acceptance trials, we learned that some acouchis will eat gum. The pair of acouchis housed in our mixed Geoffrey's and Pygmy marmoset exhibit began eating any gum that accidently landed on the floor. One of these acouchis would eat the gum directly from the syringe and would stand up on its hind legs, waiting to be fed the gum.

All of the above animals, except for the Low's squirrel and the Sugar gliders, would come surprisingly close to keepers feeding gum or they would accept hand-feeding via the syringe. This provided us with the same side benefits previously listed for the marmosets.

Figure 4. Hand-feeding gum via a syringe provides keepers with the opportunity to closely examine animals and dispense medication in a non-stressful manner. (*Photo by Lee Miller*)

We also placed natural wood gum-feeders in some of our indoor mixed-species exhibits. The feeders became a source of interest and activity to the gum-eating species as well as to the non-gum-eating species. Curiosity was stimulated and intra- and inter-species activities resulted, thus creating a more interesting environment for the animals.

DISCUSSION

Our research project has shown that natural branch gum-feeders can be used to simulate gummivory in captivity for a variety of animals. Use of natural branches/tree limbs is an inexpensive, readily available, and low maintenance method of providing environmental enrichment in an artificial setting. Simulating gummivory in captivity can be accomplished with minimal time investment and energy demand on the part of animal caretakers.

Modern zoos are attempting to exhibit animals in naturalistic settings. Ideally, the goal should be to exhibit animals in a naturalistic setting that stimulates behavioral interactions between the animals and their environment. We feel our natural branch gum-feeders help accomplish this goal.

When captive environments lack stimulus, animals are deprived of the opportunity to engage in some of their natural behaviors, which may be replaced by atypical behaviors characterized by excessive inactivity, grooming, and/or sleeping (Schoenfield, 1989). Duplicating natural habitats as much as possible in captivity encourages animals to use their innate behaviors (Hancocks, 1980).

Having the opportunity to demonstrate their natural gum-foraging behavior stimulated some of the animal's other natural behaviors, i.e., compatible sharing of feeders and feeding sites (Pygmy marmosets), methods of food acquisition (marmosets and tamarins, Golden Lion tamarins and Golden-headed Lion tamarins), and territoriality and dominance (Black-tailed marmosets). Providing feeders allowed our captive animals to emulate, to some extent, the behaviors of their wild counterparts. Gum-feeders also served as a source of interest and entertainment for young marmosets (Shepardson 1989).

Providing natural wood gum-feeders to NZP animals resulted in: increased animal activity, increased animal visibility for record- keeping and general health observations, sexing of young animals, early detection of pregnancy, non-stressful medicating of sick animals, and detection and monitoring of minor injuries or dental disorders that do not require immediate medical attention (Figure 4).

Full-length feeders presented in vertical and diagonal orientations promote and compliment the locomotor abilities of known "vertical clingers and leapers." Using the gum-feeders required the animals to use muscles that are not exercised during quadrupedal locomotion (Garber, 1984b). They provided the animals with the opportunity to assume postures not demonstrated prior to the introduction of the feeders, and they increased the amount of available, usable cage space. Simulating gummivory improved the condition of our animals and enhanced the interest and experience of our zoo visitors.

Providing interactive ways for captive animals to gain some control of their environment results in an aesthetic, interesting, potentially educational, and functionally useful exhibit. Attempts at environmental enrichment, such as simulating gummivory, could simultaneously be used to help visually demonstrate the evolutionary niche of various species while illustrating the need to conserve entire ecosystems as well as individual species.

This paper is dedicated to the memory of Yoda, a 4-year-old Black-tailed marmoset who was the catalyst for this research project.

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Grants, Fellowships....

• ASPCA AND AGC JOIN FORCES TO PROMOTE GREYHOUND ADOPTION

The American Society for the Prevention of Cruelty to Animals (ASPCA) and the American Greyhound Council (AGC), a non-profit corporation formed with the purpose of providing for the welfare of racing greyhounds, have joined together to promote greyhounds as pets.

The Greyhound Adoption Fund, made possible by a grant from the AGC, will help the ASPCA provide emergency grants to organizations involved in finding homes for greyhounds. For more information on this program contact: Greyhound Adoption Fund, ASPCA, 424 East 92nd Street, New York, NY 10128.

For information on adopting a retired greyhound, call Greyhound Pets of America at 1-800-366-1472. Make a Fast Friend, Adopt a Greyhound!

• RESEARCH FELLOWSHIP FROM THE NEW YORK ZOOLOGICAL SOCIETY (NYZS) WILDLIFE CONSERVATION SOCIETY

The NYZS Wildlife Conservation Society (formerly Wildlife Conservation International) has a fellowship program which supports projects that address the conservation of wildlife in endangered ecosystems. The projects must be directed towards activities that will help achieve concrete progress in the conservation of wild areas and their species. Proposals for research in Central America may be eligible to compete for funding from the United States Agency for International Development's Regional Office for Central America Programs. For more information contact: Dr. Mary Pearl, NYZS The Wildlife Conservation Society, International Programs, 185th Street and Southern Blvd., Bronx, NY, 10460-1099, Tel: (718) 220-5155, Fax: (718) 364-4275 or Ing. Claudio Saito, NGO Advisor, Regional Office for Central America Programs, 2a. Avenida 9-01, Zona 10, Guatemala, Guatemala 01010, Tel: 502-2-313515 or 502-2-318973, Fax: 502-2-320495.

• ZOO KEEPER GRANTS IN ZOOLOGY

The American Association of Zoo Keepers (AAZK) provides funding for original keeper-initiated research on behavioral and/or biomedical topics or general zoo management principles. To be eligible for this grant, applicants must be AAZK members and employed as a full-time keeper in a zoo or aquarium. Applications are due by March 31, 1994. For more information, contact: Susan M. Barnard, AAZK Research/Grants Committee, Department of Herpetology, Zoo Atlanta, 800 Cherokee Ave. S.E., Atlanta, GA 30315.

• BIOLOGICAL BASIS OF BEHAVIOR PROGRAM

The National Science Foundation provides support for behavioral research into the biological factors that underlie the behavior of animals. Research on genetic, environmental, hormonal, neural, and developmental and other anatomical and physiological determinants of behavior is supported. Research grants of up to $100,000 are available. For more information, contact: Program Director, National Science Foundation, Division of Behavioral and Neural Sciences, 1800 G Street, N.W., Washington, DC 20550, Tel: (202) 357-7949.

Legislation cont'd from p.1

full-text results of biomedical research; promote the creation and use of modern technologies, including audiovisual aids and computer graphics, for teaching and demonstrations. Related bills, H.R. 1389, March 1991; H.R. 560, January 1989; H.R. 1708, March 1987; H.R. 5486, September 1986; H.R. 1145, February 1985.

- **H.R. 1455 To provide for the protection of veal calves.**

Introduced March 24, 1993, by Andrew Jacobs, Jr. (D-IN) and referred to the Committee on Agriculture.

No person shall raise a calf for production of veal unless the following requirements are met. The calf must be free to turn around without difficulty, lie with its legs outstretched, and groom itself without an impediment such as too small an enclosure or chaining or tethering. The calf must be fed a daily diet containing sufficient iron, and if the calf is more than 14 days old, it must be fed sufficient digestible fiber to prevent anemia and sustain health. Related bills, H.R. 252, January 1991; H.R. 84, January 1989; H.R. 2857, July 1987.

- **H.R. 1955 To require the President to impose economic sanctions against countries that engage in whaling not authorized and approved by the International Whaling Commission.**

Introduced May 4, 1993, by Peter A. DeFazio (D-OR) and referred jointly to the Committees on Merchant Marine and Fisheries, Ways and Means, and Foreign Affairs. This act may be cited as "The International Whaling Moratorium Enforcement Act of 1993."

Not later than January 1, 1994, the President shall certify to Congress each country that has not completely ceased forbidden whaling operations. Countries that have not ceased whaling operations will be prohibited from importing fish and fish products into the United States. If these sanctions are insufficient to stop the country from engaging in forbidden whaling operations, the President is authorized to impose additional economic sanctions, including the imposition of duties, import bans, or restricting goods. Related bills, H.R. 5569, July 1992; H.Con.Res. 177, July 1991.

- **H.R. 1490 To reauthorize and amend the Endangered Species Act of 1973 to improve and protect the integrity of its programs for the conservation of threatened and endangered species, to ensure balanced consideration of all impacts of decisions implementing the act, to provide for equitable treatment of non-Federal persons and Federal agencies under the act, to encourage non-Federal persons to contribute voluntarily to species conservation, and for other purposes.**

Introduced March 25, 1993, by W.J. Tauzin (D-LA) and referred to Committee on Merchant Marine and Fisheries. This act may be cited as the "Endangered Species Act Procedural Reform Amendments of 1993."

The Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) is amended by adding a request for peer review before determining that a species is threatened or endangered, or designating critical habitat. Other amendments include improvements in data collection and analysis to make determinations about a species status, and ensuring the preparation and use of timely, comprehensive, and effective recovery plans. Related bills, S. 3159, August 1992; H.R. 4045, November 1991.

- **H.R. 1066 To implement the Protocol on Environmental Protection to the Antarctic Treaty, and for other purposes.**

Introduced February 23, 1993, by Gerry E. Studds (D-MA) and referred jointly to the Committees on Merchant Marine and Fisheries, Science, Space, and Technology, and Foreign Affairs. This act may be cited as the "Antarctic Environmental Protocol Act of 1993."

It is unlawful for any person to conduct an activity within Antarctica, including scientific research, expeditions, and logistical support to U.S. facilities and bases, in a manner inconsistent with the Protocol. Unlawful acts include open burning, introducing dogs to Antarctica, use of leaded fuel, taking of native mammals, birds, plants, or protected species, except as authorized by permit, introducing any animal or plant not indigenous to Antarctica, and discharging untreated sewage into the waters or ice shelves. Section 6 outlines under what conditions permits may be issued for taking plants or animals from Antarctica. Related bills, S.3189, August 1992; and H.R. 5801, August 1992. ■

Cynthia Smith, Info. Specialist

• POSTPONEMENT OF ANIMAL WELFARE EDUCATION WORKSHOP

The **"Southeastern Animal Welfare Education Workshop"**, cosponsored by Louisiana State University Medical Center and Xavier University of Louisiana and scheduled for December 2-3, 1993, at the Monteleone Hotel in New Orleans, LA, has been postponed and will be rescheduled in 1994.

Announcements for the proposed date will appear in the NIH Guide for Grants and Contracts and similar publications.

For more information contact:
Division of Animal Welfare, OPRR
National Institutes of Health
9000 Rockville Pike
Building 31, Room 5B62
Bethesda, MD 20892
Telephone: 301-496-7163
Fax: 301-402-2803

• THE WELL-BEING OF BIRDS IN LABORATORY AND FIELD RESEARCH

The Scientists Center for Animal Welfare (SCAW) will sponsor a conference on **"The Well-being of Birds in Laboratory and Field Research"** on December 3, 1993, at the Doubletree Hotel in Crystal City, Virginia.

This conference will address issues concerning the well-being of birds used in laboratory and field research. Current regulations and guidelines do not always provide guidance to investigators, animal care givers, and Animal Care and Use Committees. Some of the topics covered will include:

* **General Behavioral Considerations in the Laboratory**
* **Disease Diagnosis and Control**
* **Anesthesia, Analgesia and Euthanasia**
* **Surgical and Post-Surgical Care**

Also, workshops will be held on the care and treatment of specific species of birds in research. A session on field techniques will cover capture, marking, field euthanasia and removal from and return to the wild.

Researchers, regulatory personnel, members of Animal Care and Use Committees, administrators, and others interested in these issues are encouraged to attend. For more information, contact: Conferences, SCAW, 4805 St. Elmo Avenue, Bethesda, MD 20814, tel: (301)654-6390, fax: (301)907-3993.

• RESEARCH ANIMAL ANESTHESIA, ANALGESIA AND SURGERY

SCAW will sponsor a 2-day conference entitled **"Research Animal Anesthesia, Analgesia and Surgery"** on May 12-13, 1994, in Atlanta, Georgia.

Topics to be covered include:

* USDA, NIH and AAALAC Requirements for Surgical Programs
* American Society of Laboratory Animal Practitioners' Guidelines
* Surgical Training and Personnel Qualifications
* Laparoscopic Surgery Courses
* Ethics and Science of Xenotransplantation and Xenoperfusion Recognizing Pain and Distress in Research Animals
* Physiologic Effects of Anesthetics and Analgesics
* Anesthesia and Analgesia for Specific Species
* Intraoperative Monitoring and Equipment
* Cardiopulmonary Bypass and ECMO
* Cardiopulmonary Complications and Emergencies in Surgery
* Post-surgical Care

Researchers, regulatory personnel, members of Animal Care and Use Committees, administrators, and others interested in these issues are encouraged to attend. For more information, contact: Conferences, SCAW, 4805 St. Elmo Avenue, Bethesda, MD 20814, tel: (301)654-6390, fax: (301)907-3993.

• NEW PUBLICATION

SCAW will publish proceedings of the conference "Rodents and Rabbits: Current Research Issues," held on May 21, 1993, in Washington, D.C. The conference, cosponsored with Working for Animals Used in Research, Drugs, and Surgery (WARDS), addressed issues concerning the well-being of rabbits and rodents used in research. The expected publication date is December 1993.

Topics will include:

* Request for Changes in USDA Regulations Martin L. Stephens, PhD
* Recognizing Stress in Rodents and Rabbits, Gerald F. Gebhart, PhD
* Enrichment Techniques for Rodents and Rabbits, David Morton, BVSC, PhD, MRCVS
* Transgenic Rodents, Terry Cunliffe-Beamer, DVM
* Anesthesia and Analgesia for Rodents and Rabbits, Sally Wixson VMD, MS
* Aseptic Surgery for Rodents, Marilyn J. Brown, DVM, MS
* Adjuvant Selection, David K. Johnson, DVM

For more information contact: SCAW, 4805 St. Elmo Avenue, Bethesda, MD 20814, tel: (301)654-6390, fax: (301)907-3993.

• HUMAN TISSUE AVAILABLE FOR RESEARCH INTO DEVELOPMENTAL DISORDERS

The National Institute of Child Health and Human Development (NICHD) has contracted for the collection of tissues to further research into human developmental disorders such as chromosomal disorders, encephalopathies, aminoacidopathies, leukodystrophies, lysosomal disorders, neurological disorders, sudden infant death syndrome (SIDS), unexplained mental retardation, and autism.

Tissue is currently available for distribution from over 140 cases including SIDS infants, chromosomal disorders (primarily fetal tissue), non-affected cases, accidental deaths, deaths from known causes (primarily infection and congenital abnormalities), anencephaly, depression, hydrocephalus, seizure disorders, spina bifida, etc.

For more information regarding this research resource, contact:

Felix de la Cruz, M.D.
Center for Research for Mothers and Children
NICHD
6100 Building, Room 4B09
Bethesda, MD 20892
Tel: (301) 496-1383

Marian Willinger, Ph.D.
Center for Research for Mothers and Children
6100 Building, Room 4B03
Bethesda, MD 20892
Tel: (301) 496-5575

• DIAL UP THE RULES ON CARING FOR ANIMALS, THE USDA ADVISES

HYATTSVILLE, Md. – The U.S. Department of Agriculture is now providing current animal welfare state and federal regulation information to licensed animal dealers and exhibitors through an electronic messaging system called the Voice Response System (VRS). In a continued effort to increase the public's awareness of animal welfare information, USDA's Animal and Plant Health

Inspection Service, animal care staff has added up-to-date animal transportation information on the VRS. The VRS is accessible 24-hours a day, 365 days a year. Callers with a touchtone telephone can connect to VRS by dialing 1-800-545-USDA (8732).

Once connected to VRS, callers have three options to choose from the main menu. Option 1 provides emergency notices for livestock movement and option 2 gives a listing of state regulations for moving livestock.

With option 3, dealers and other groups, licensed or regulated by the Animal Welfare Act, can access animal care information containing federal requirements for the transportation of dogs and cats. Identification and record-keeping requirements for those species are also available on the VRS system.

Options at the end of each section allow callers to access additional information or return to the previous menu. Pressing 0 at any time returns the caller to the previous menu.

The animal care menu options are as follows:

Transportation

1. Shipping
2. Food and water requirements
3. Age, size and number restrictions
4. Transport cages
5. Temperature and handling requirements
6. Additional requirements for airlines
0. Return to animal care menu

Records

1. Acquisitions
2. Dispositions
3. Births
0. Return to animal care menu

Identification of Animals

1. Dealers
2. Exhibitors
0. Return to animal care menu

The animal care transportation guidelines on VRS pertains only to USDA-licensed dealers, exhibitors, and animal transporters, including airlines. Pet owners who plan to ship or travel with their pets should be aware of these regulations, and are encouraged to work closely with airline representatives to ensure safe, trouble-free transportation. Airlines cannot accept shipments of regulated animals that do not comply with regulations.

Callers also may leave comments or suggestions for improvement of VRS but not legal questions about the movement of animals, or requests for interpretation of laws or regulations.

Questions on animal care or regulatory enforcement issues should be addressed to: Dale F. Schwindaman, USDA, APHIS, REAC, 6505 Belcrest Road, Room 558 Federal Building, Hyattsville, Md. 20782.

For more information on the VRS system, contact: Sue Coburn, USDA, APHIS, VS, Centers for Epidemiology and Animal Health, 555 S. Howes, Suite 300, Ft. Collins, Colo., phone (303) 490-7900, or fax (303) 490-7999. ■

USDA Announces Amendment to the Animal Welfare Act

The U.S. Department of Agriculture has announced it is amending Animal Welfare Act regulations to help prevent the use of lost and stolen pets in research, by giving pet owners more time to find their pets and by requiring more documentation from dealers who sell animals to researchers.

Under the new regulations, which took effect Aug. 23, pounds and animal shelters must hold dogs and cats for at least five days, including a Saturday, before releasing them to dealers. The new regulations also require a written certification that the holding period has been met and that the dealer has notified the pound or shelter that the animal may be used for research.

"We believe the new holding period provides a reasonable time for lost pets to be recovered by their owners or adopted," said Dale F. Schwindaman, deputy administrator for Regulatory Enforcement and Animal Care in USDA's Animal and Plant Health Inspection Service. "The certificates will also enable dogs and cats to be traced to their ultimate destination."

Schwindaman said individual shelter operators and state or local governments previously set the holding periods. APHIS estimates that most facilities held their animals for about 3 days before releasing them to dealers. The new requirements may affect up to 3,800 pounds and shelters in the United States.

The final regulations were published in the July 22 Federal Register as Docket 91-035-3.

Cynthia Eck
Steve Lombardi
USDA, Office of Public Affairs
Release No. 061893

Electronic Information Products Available From AWIC

The Animal Welfare Information Center (AWIC) is compiling an electronic library of full-text animal welfare information which will be updated periodically. The files are in WordPerfect 5.1 and Ascii formats and are provided free of charge. There are currently two volumes.

Requestors of electronic material must provide formatted **high-density** floppy disks. To request Volume 1 and Volume 2, you will need a total of 3 **high-density** disks. For more information about contributing or receiving information for the electronic documents project, contact AWIC, Room 205, National Agricultural Library, 10301 Baltimore Blvd., Beltsville, MD 20705. Tel: 301/504-6212; Fax:301/504-5472

VOLUME I: ANIMAL WELFARE LEGISLATION AND POLICIES

- Animal Welfare Act, Amendments, and Regulations
- Public Health Service Policy, Guide, and Health Research Extension Act of 1985, Section 495
- Animal Enterprise Protection Act of 1992
- Good Laboratory Practice for Nonclinical Laboratory Studies (21CFR)
- Good Laboratory Practice Standards (40CFR)

VOLUME II: ANIMAL WELFARE RECOMMENDATIONS AND RESOURCES

- AAALAC Position Statements
- AAALAC Rules of Accreditation
- Education and Training in the Care and Use of Laboratory Animals: A Guide for Developing Institutional Programs (National Research Council)
- National Institutes of Health Nonhuman Primate Management Plan
- "Recommendations for the Care of Amphibians and Reptiles in Academic Institutions." ILAR News 33(4):Sl-S21
- Essentials for Animal Research: A Primer for Research Personnel (NAL/University of Illinois)
- Audio-visuals Relating to Animal Care, Use and Welfare (AWIC Series 93-01)
- Information Resources for Reptiles, Amphibians, Fish, and Cephalopods Used in Biomedical Research (AWIC Dec.1992)
- Animal Care and Use Committees (SRB 92-16)
- Environmental Enrichment Information Resources for Nonhuman Primates: 1987-1992 (AWIC)

"Meeting the Information Requirements of the Animal Welfare Act."

A Workshop

The Animal Welfare Information Center (AWIC) of the National Agricultural Library (NAL) has developed a 2 day workshop for individuals who are responsible for providing information to meet the requirements of the Animal Welfare Act.

The act requires that investigators provide Institutional Animal Care and Use Committees (IACUC) with documentation demonstrating that a thorough literature search was conducted regarding alternatives. An alternative is any procedure which results in the reduction in the numbers of animals used, refinement of techniques, or replacement of animals.

The objectives of the workshop are to provide:

1. an overview of the Animal Welfare Act and the information requirements of the act.
2. a review of the alternatives concept.
3. a comprehensive introduction to NAL, AWIC and other organizations.
4. instruction on the use of existing information databases/networks.
5. on-line database searching experience.

This workshop is targeted for principal investigators, members of IACUCs, information providers, administrators of animal use programs, and veterinarians. All participants will receive a resource manual.

Workshops will be held on March 10-11, June 23-24, September 22-23, and December 8-9, 1994. Each workshop will be limited to 12 persons.

For more information, contact AWIC at Telephone (301) 504-6212, Fax (301) 504-5472, or write to:

Animal Welfare Information Center
National Agricultural Library
10301 Baltimore Boulevard
Beltsville, MD 20705-2351

Upcoming Meetings...

National Science Teachers Association, Eastern Area Convention, December 16-18, 1993. Orlando, FL. Contact: (202) 328-5800.

OstrichFest '94, The American Ostrich Association, February 17-20, 1994. San Diego, CA. Contact: (817) 731-8597.

National Science Teachers Association, 1994 NSTA National Convention, March 30-April 2, 1994. Anaheim, CA. Contact: (202) 328-5800.

Congress of the International Primatological Society, July 19-24, 1994. Bali, Indonesia. Contact: (202) 223-6971 - Dr. Soegardjito.

First World Congress on Computational Medicine, Public Health and Biotechnology, April 24-28, 1994. Austin, TX. Contact: (512) 471-2472.

New Publications Available from AWIC...

- QB 93-07 Housing, Husbandry, and Welfare of Beef Cattle
- QB 93-52 Housing, Husbandry, and Welfare of Rodents
- QB 93-58 Housing, Husbandry, and Welfare of Dairy Cattle
- AWIC Series #11 Animal Welfare Legislation: Bills and Public Laws, 1992

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ISSN 1050-561X

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